

**2010**

**Hydrocarbon and By-Product Reserves  
in British Columbia**



## About the BC Oil and Gas Commission

---

The BC Oil and Gas Commission is an independent, single-window regulatory agency with responsibilities for overseeing oil and gas operations in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Commission's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected through the objectives of ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

# Hydrocarbon and By-Product Reserves in British Columbia

December 14, 2011

## TABLE OF CONTENTS

Summary .....	4
Discussion .....	
A. Oil Reserves .....	5
B. Gas Reserves .....	7
C. By-Product Reserves .....	12
D. Additional Information .....	13
Figures .....	
1. Historical Remaining Oil Reserves vs R/P Ratio .....	5
2. Historical Remaining Oil Reserves vs Annual Production .....	6
3. Oil Reserves – Reserve Additions per Well Drilled .....	6
4. Historical Remaining Gas Reserves vs R/P Ratio .....	8
5. Historical Remaining Gas Reserves vs Annual Production .....	9
6. Gas Reserves – Reserve Additions per Well Drilled .....	9
7. Conventional vs Unconventional Gas in NEBC .....	10
8. Horn River Basin .....	11
9. Reserves by Geological Period .....	11
10. Sour Gas (H <sub>2</sub> S) Map of Northeast British Columbia .....	12
11. Reserves by Geological Period .....	19
12. Unconnected Gas Reserves by Plant Area .....	28
Tables .....	
I Established Hydrocarbon Reserves (SI Units) .....	14
II Established Hydrocarbon Reserves (Imperial Units) .....	14
III Historical Record of Established Reserves .....	15
IV Established Oil Reserve Changes .....	17
V Established Raw Gas Reserve Changes .....	18
VI(a) Initial Recoverable Oil Reserves by Geological Period .....	20
VI(b) Initial Recoverable Raw Gas Reserves by Geological Period .....	22
VII Oil Pools Under Waterflood .....	26
VIII Oil Pools Under Gas Injection .....	27
IX Unconnected Gas Reserves by Plant Area .....	28
X Project/Unit Cross-Reference Listing .....	29
Definitions .....	30

## SUMMARY

This report presents estimates of British Columbia's oil, natural gas and associated by-product reserves as of Dec. 31, 2010. The estimates have been prepared by the BC Oil and Gas Commission (Commission) utilizing the most currently available geologic and reservoir interpretations. The reserve estimates represent established reserves and are based on accepted geological and engineering practices.

British Columbia's Remaining Established Reserves as of Dec. 31, 2010, together with a comparison of the Dec. 31, 2009 reserves, are summarized below.

### Remaining Established Reserves

		2009	2010
<b>OIL</b>		19.3 10 <sup>6</sup> m <sup>3</sup> (121.5 MMSTB)	18.7 10 <sup>6</sup> m <sup>3</sup> (117.7 MMSTB)
<b>GAS</b>	Total, raw	657.9 10 <sup>9</sup> m <sup>3</sup> (23.4 TCF)	932.0 10 <sup>9</sup> m <sup>3</sup> (33.1 TCF)
	<b>Unconnected Gas</b>		
	Raw	20.1 10 <sup>9</sup> m <sup>3</sup> (0.680 TCF)	22.3 10 <sup>9</sup> m <sup>3</sup> (0.714 TCF)
<b>BY-PRODUCTS</b>			
	LPG	26.7 10 <sup>6</sup> m <sup>3</sup> (158.7 MMSTB)	28.9 10 <sup>6</sup> m <sup>3</sup> (168.0 MMSTB)
	Pentanes+	10.3 10 <sup>6</sup> m <sup>3</sup> (61.7 MMSTB)	11.1 10 <sup>6</sup> m <sup>3</sup> (64.8 MMSTB)
	Sulphur	14.9 10 <sup>6</sup> tonnes (14.7 MMLT)	14.4 10 <sup>6</sup> tonnes (14.2 MMLT)

## DISCUSSION

### A. Oil Reserves

The province's oil production for the 2010 calendar year was  $1,270 \times 10^3 \text{ m}^3$ ,\* which is a decrease of 2009's volume of  $1,282 \times 10^3 \text{ m}^3$ . Nineteen oil wells (Fig. 3) were drilled during 2010, reverting to the more normal range of oil wells to be drilled in the province. This reduction in drilling was a contributing factor to the remaining oil reserves at Dec. 31, 2010 dropping back to  $18.7 \times 10^6 \text{ m}^3$  from  $19.3 \times 10^6 \text{ m}^3$  in 2009.

A review of a number of oil pools resulted in reductions of the recovery factor or a depletion of the pools, which decreased the remaining reserves to production ratio (R/P ratio) from 15.1 years in 2009 to 14.7 years in 2010 (Figures 1 and 2).

The largest positive revision resulted from a performance review of the Boundary Lake A pool within the Boundary Lake area. This revision accounted for  $249 \times 10^3 \text{ m}^3$  or 37 per cent of the total revisions in 2010. Overall changes to oil reserves due to revisions in 2010 yielded an increase of  $643 \times 10^3 \text{ m}^3$ .

Drilling activity resulted in one new oil pool being discovered – Cache Creek Doig BB. This single well new pool increased the Initial Reserves by  $28.4 \times 10^3 \text{ m}^3$ . The lack of oil well drilling activity generated a decrease to the reserves added per well drilled dropping the value from  $66.3 \times 10^3 \text{ m}^3$  in 2009 to  $47 \times 10^3 \text{ m}^3$  in 2010 (Figure 3).

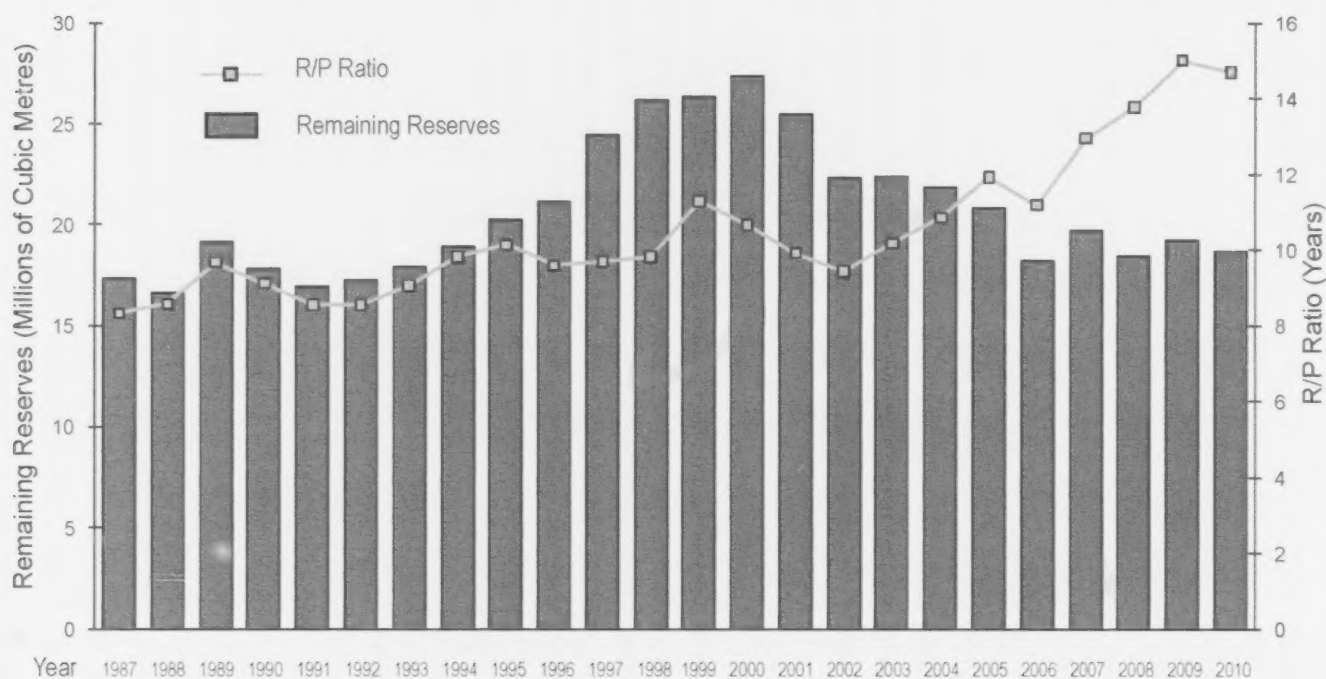
British Columbia's oil reserves continue to be dominated by secondary recovery schemes. Waterflood pools account for approximately 50 per cent of remaining oil reserves (Table VII) with Hay River and Boundary Lake still being the dominant contributors.

Gas injection is currently occurring in four pools (Table VIII) and contributes about one per cent to the provincial remaining reserves.

\*Note: 2010 oil production figures have been adjusted to actual production volumes from the Ministry of Finance.

\*\*Note: 2009 oil production figures have been adjusted to actual figures from the Ministry of Finance.

Figure 1: Historical Remaining Oil Reserves Versus R/P Ratio



## DISCUSSION

Figure 2: Historical Remaining Oil Reserves Versus Annual Production

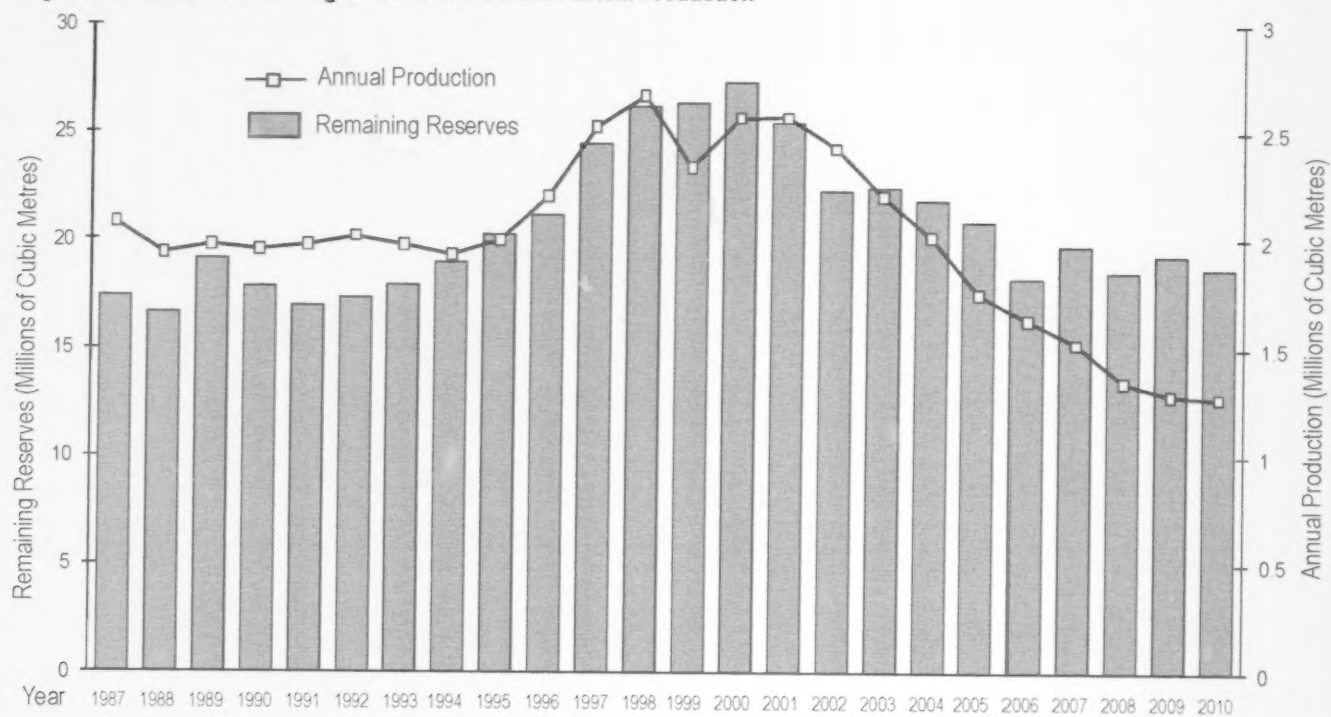
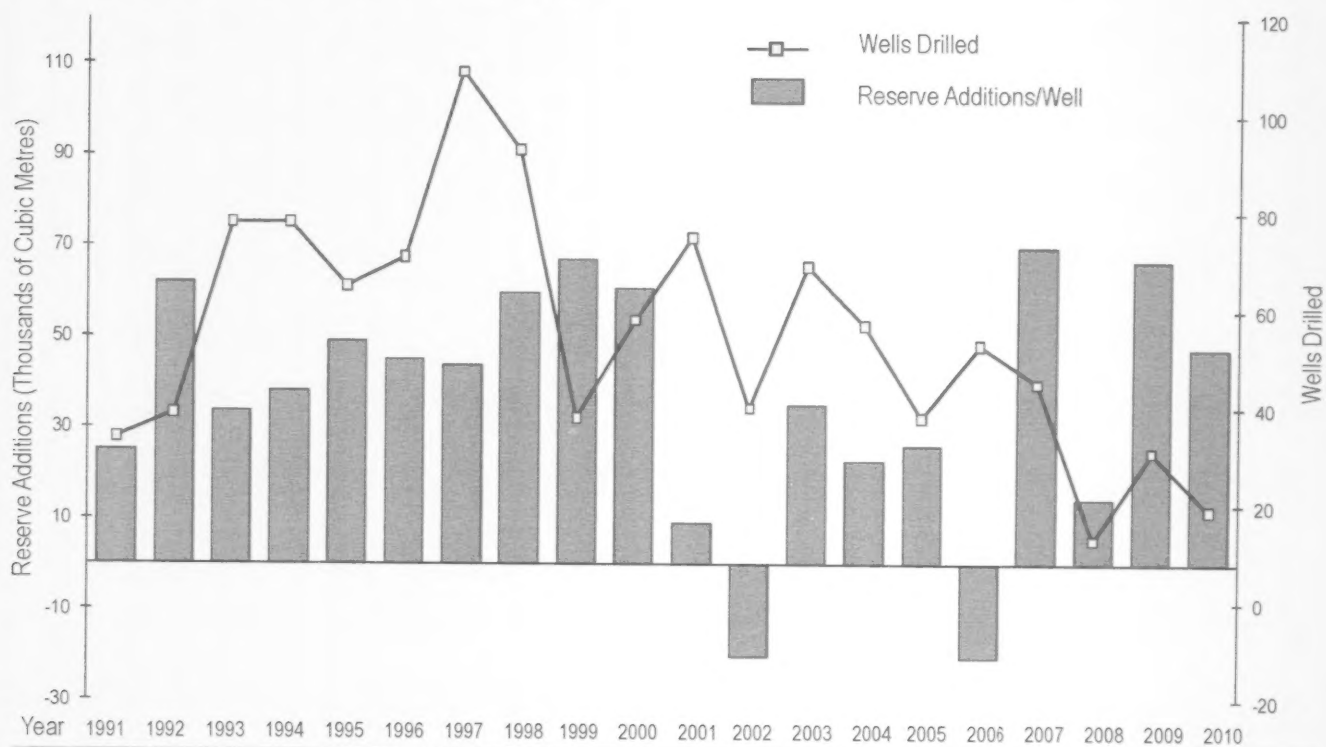


Figure 3: Oil Reserves - Reserve Additions Per Well Drilled





## DISCUSSION

### B. Gas Reserves

The province's established remaining reserves of raw natural gas were  $932 \times 10^9 \text{ m}^3$  as at Dec. 31, 2010, an increase of  $274 \times 10^9 \text{ m}^3$  and a 42 per cent increase over the 2009 year-end reserves. This represents the highest level of established remaining raw gas reserves and the largest yearly increase in the province's history, continuing a 10-year trend of increases.

Raw natural gas production for the year, as reported in this publication, was  $33.2 \times 10^9 \text{ m}^3$ , a slight increase over the preceding year's published production. The raw gas production for the year 2010 as reported by the Mineral, Oil and Gas Revenue Branch of the Ministry of Finance was  $35 \times 10^9 \text{ m}^3$ , a slight increase over last year's reported production. The discrepancy in reported raw gas production between agencies is due to the fact that the Commission only reports raw natural gas production for wells associated with gas pools that have been assigned established reserves.

Conventional production and reserve additions have been on the decline over the past decade. In 2010, 134 wells were drilled for conventional targets with initial raw gas reserve additions totalling  $18.6 \times 10^9 \text{ m}^3$ . Notable revisions during 2010 included

the Burnt River Belcourt A, which saw an overall increase of Initial Reserves to  $1.8 \times 10^9 \text{ m}^3$  and Groundbirch Doig A seeing an increase of  $1.7 \times 10^9 \text{ m}^3$ .

The development of B.C.'s large, unconventional gas deposits has contributed to the bulk of the reserves additions for 2010. For this reporting period, a review of activity in the Horn River Basin shale gas play has resulted in an increase in initial raw gas reserves of approximately  $291 \times 10^9 \text{ m}^3$  (10 TCF) based on  $10,923 \times 10^9 \text{ m}^3$  (40 TCF) of original gas in place and a 25 per cent recovery factor. Six new pools have been designated — three in the Muskwa-Otter Park formation and three in the Evie formation. There were some other notable revisions during 2010 including the Sierra Jean Marie which saw an overall increase of Initial Reserves to  $5.7 \times 10^9 \text{ m}^3$  and Kobes Doig Phosphate Montney C seeing an increase of  $3.4 \times 10^9 \text{ m}^3$ .

As of December 2010, there were a total of 98 producing shale gas wells in the Horn River Basin; many still held confidential under terms of Experimental Scheme approvals. Production from the Horn River group of formations accounted for 10 per cent of total production in the province.

Horn River	2010	2009
Producing wells	98	46
Cumulative Gas Prod (BCF)	74	31
Gas Trend Daily rate (MMCF/D)	392	134

The Montney tight gas trend continued to be the most active natural gas play in British Columbia. 383 wells targeted the Montney formation accounting for 57 per cent of all wells drilled in 2010 and extending the play to the northwest into the fields of Altares and Town.

Montney production accounted for 26 per cent of the total production within the province. Reserve values have remained unchanged for 2010; however, an evaluation of overall reserves will be conducted for the 2011 report with expected significant upward revision.

Montney	2010	2009
Producing wells	603	386
Cumulative Gas Prod (BCF)	577	319
Gas Trend Daily rate (MMCF/D)	918	450

## DISCUSSION

One of the first unconventional resource plays in British Columbia was the Jean Marie formation. This formation has been on continuous production since the early 1980s and production peaked during the years from 2004-2006. With a 30 year history this play is now at a mature development stage, but a large expanse of undrilled acreage remains to be explored. The Jean Marie formation had 95 new wells drilled in 2010 and accounted for just over 10 per cent of the annual production.

Jean Marie	2010	2009
Producing wells	1,598	1,520
Cumulative Gas Prod (BCF)	1,913	1,783
Gas Trend Daily rate (MMCF/D)	323	336

Figure 4: Historical Remaining Gas Reserves Versus R/P Ratio

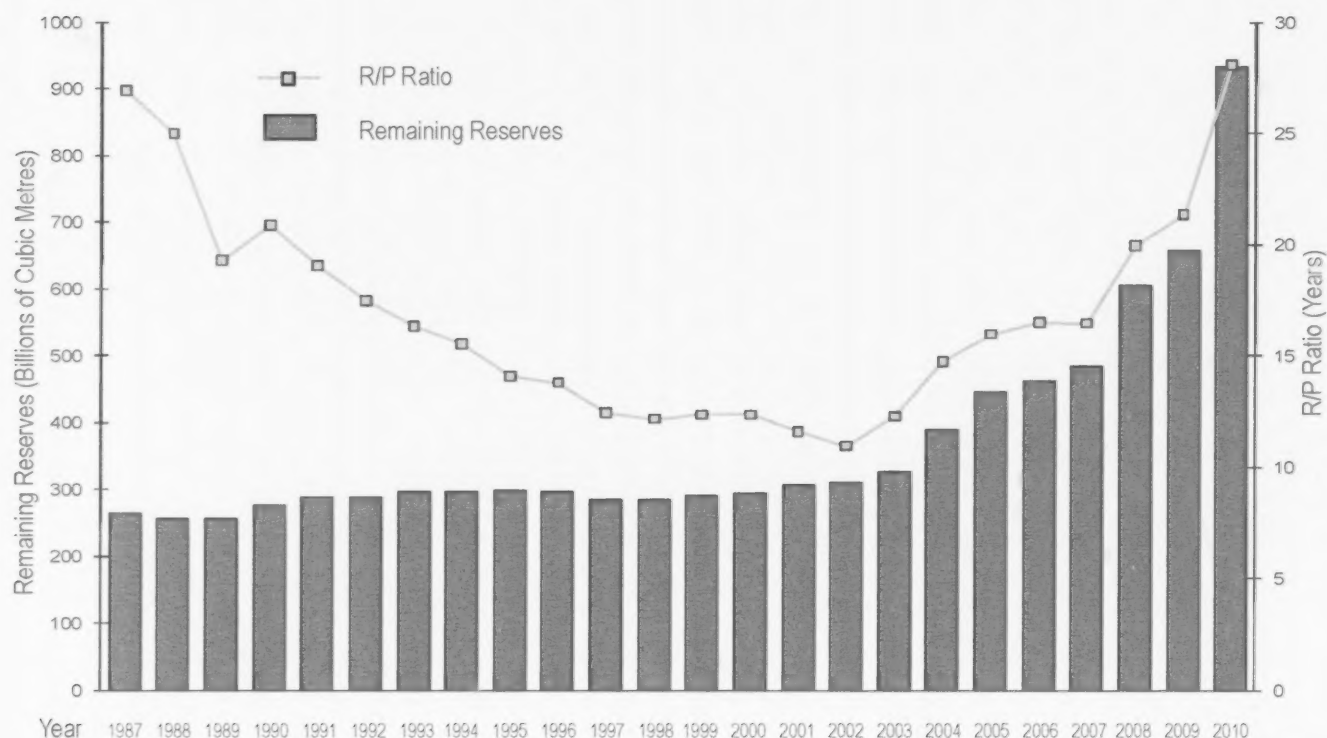




Figure 5: Historical Remaining Gas Reserves Versus Annual Production

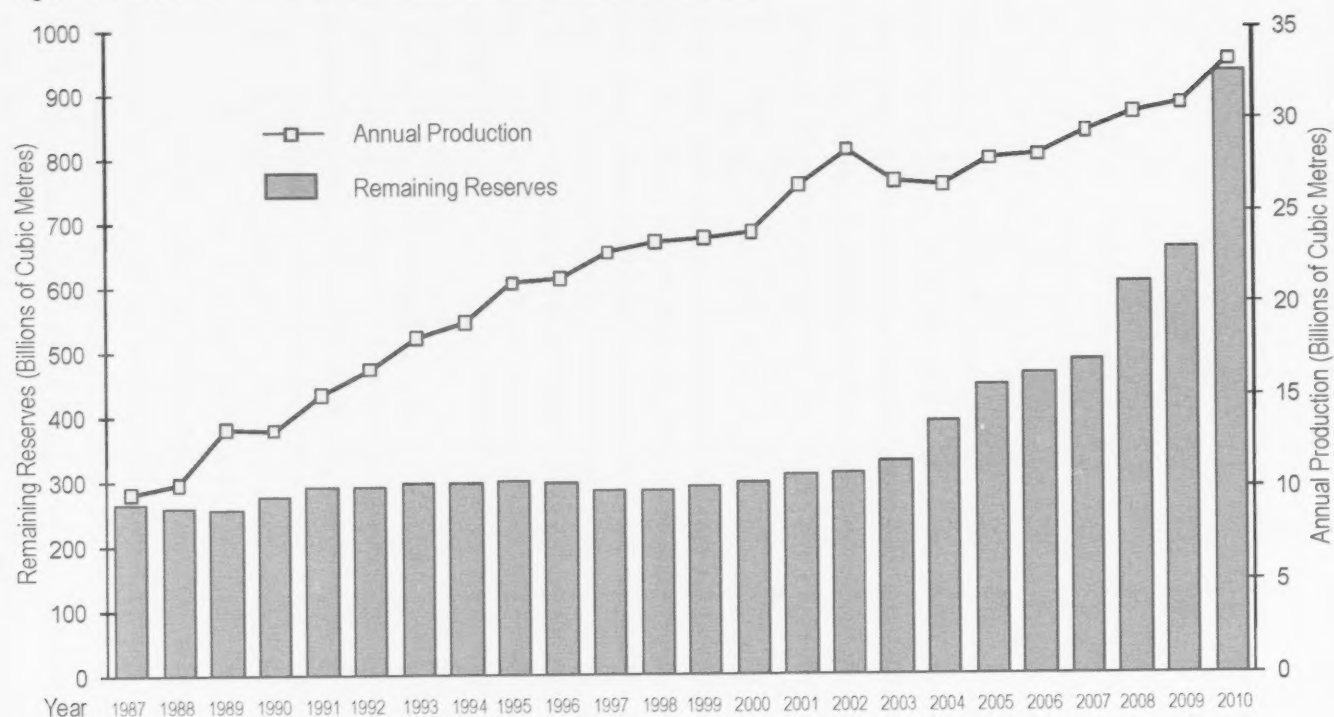


Figure 6: Gas Reserves - Reserve Additions Per Well Drilled

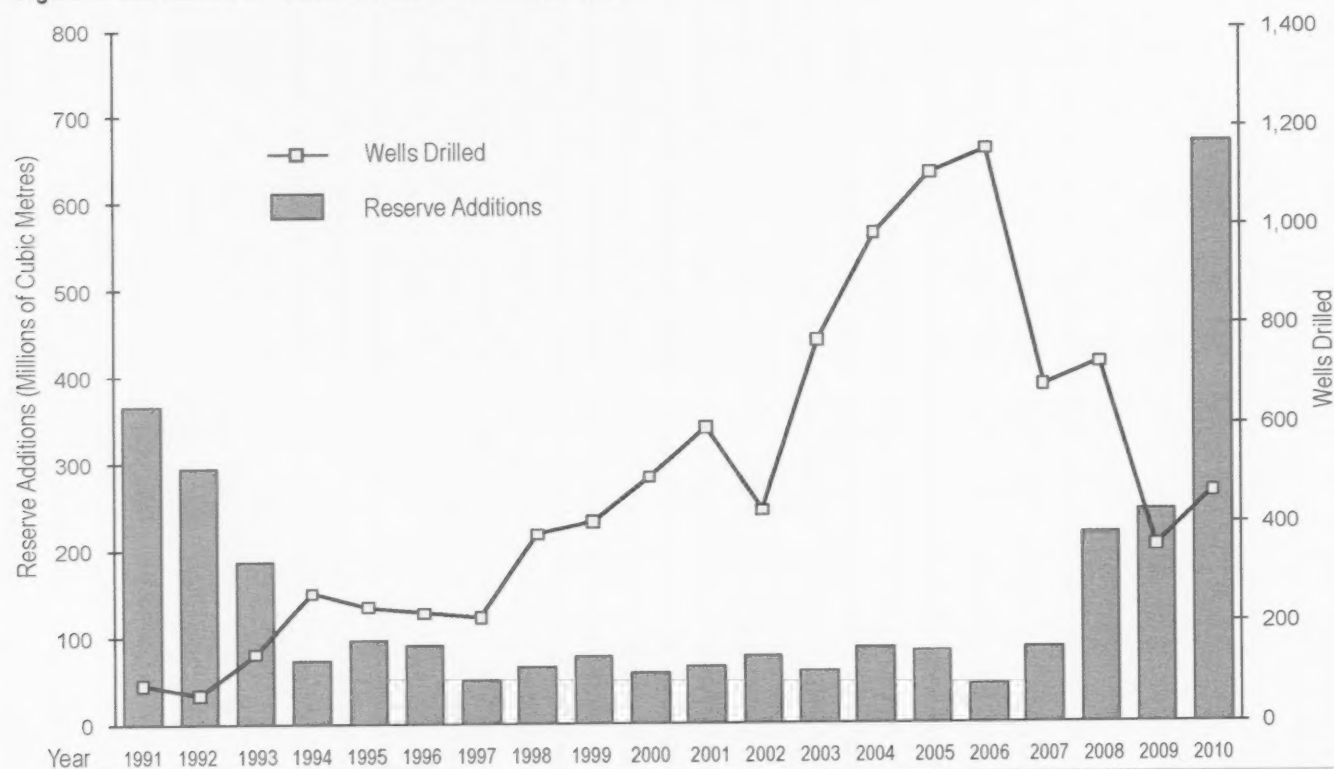


Figure 7: Conventional Versus Unconventional Gas in NEBC

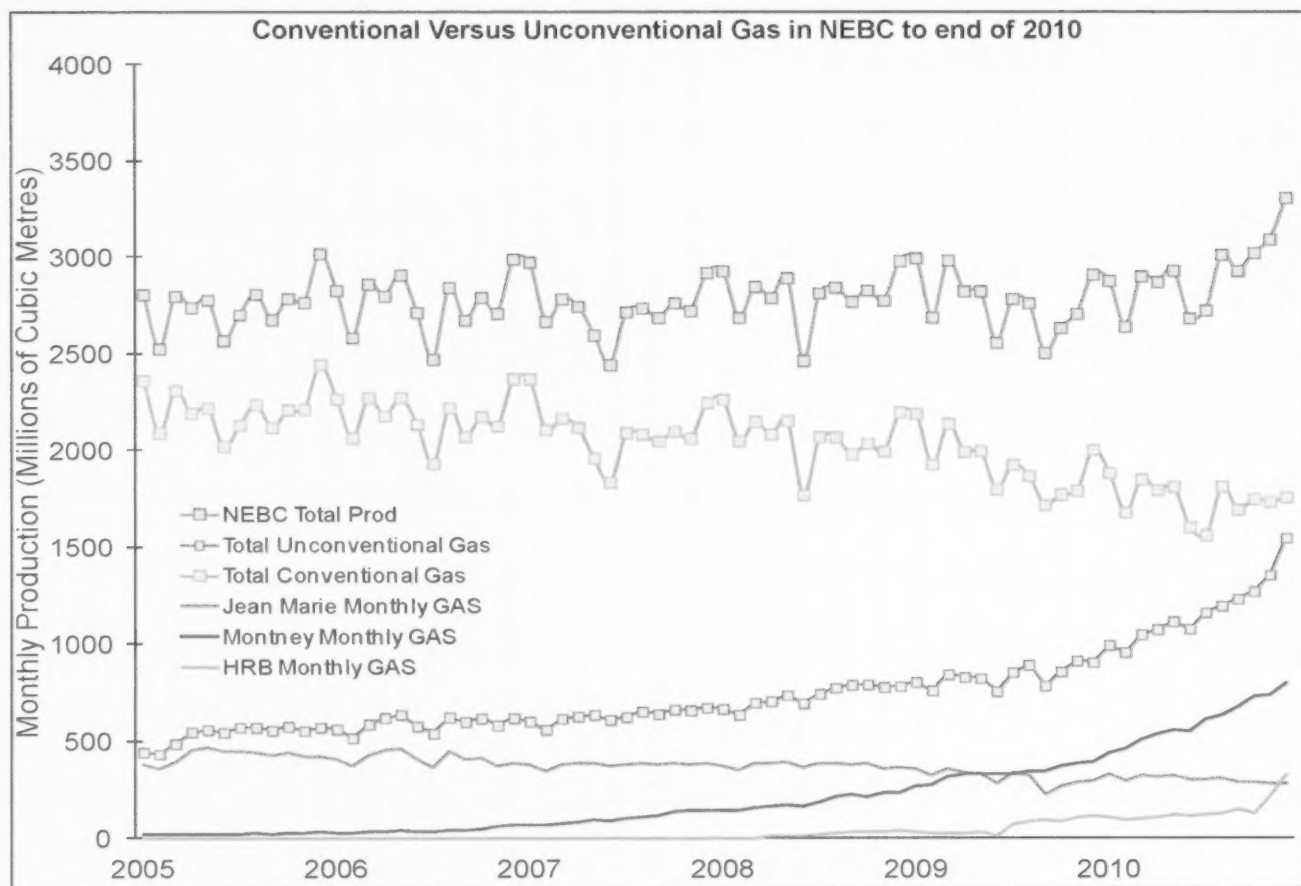


Figure 8: Horn River Basin



Figure 9: Montney



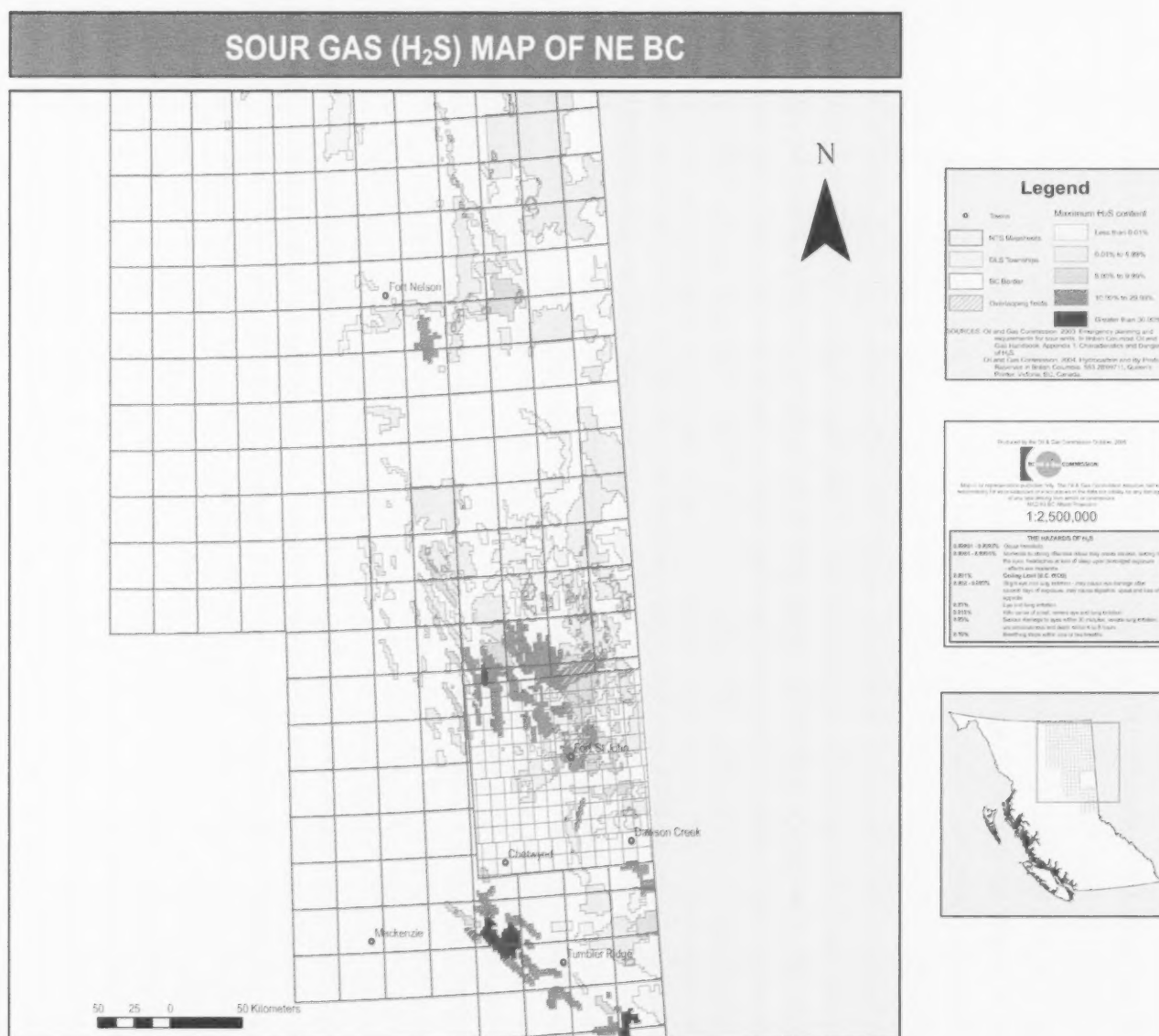
## DISCUSSION

### C. By-Product Reserves

Established remaining reserves of liquefied petroleum gases (LPG) increased for the fifth year to  $28.9 \times 10^6 \text{ m}^3$ , as compared to  $26.7 \times 10^6 \text{ m}^3$  at year-end 2009. Established remaining reserves of pentanes plus (C5+) increased for the third year to  $11.1 \times 10^6 \text{ m}^3$  from  $10.3 \times 10^6 \text{ m}^3$ . Established remaining reserves of sulphur decreased slightly to  $14.4 \times 10^6 \text{ t}$  from  $14.9 \times 10^6 \text{ t}$  in 2009. Figure 10 shows the distribution of sour gas ( $\text{H}_2\text{S}$  percentage) throughout Northeast British Columbia.

For gas pools on production, the by-products reserves are estimated on the basis of the yield from raw gas reserves achieved at the plant to which the gas is delivered. For pools yet to be connected to a plant, the yields are estimated based on gas composition and capacity of the plant to which the pool is expected to be connected.

Figure 10: Sour Gas Map of NE BC



## DISCUSSION

---

### D. Additional Information

The Hydrocarbon and By-Product Reserves in British Columbia statistical information will continue to be offered to industry through the website [www.bcogc.ca](http://www.bcogc.ca) under Web Applications/Data Downloads. In an effort to reduce paper waste, hardcopies are not available.

**For additional information on the content of this report, contact:**

Glynis Farr  
Resource Development Division  
Oil and Gas Commission  
300, 398 Harbour Rd  
Victoria, British Columbia V9A 0B7  
PHONE: 250-419-4427 FAX: 250-419-4402  
[Glynis.Farr@bcogc.ca](mailto:Glynis.Farr@bcogc.ca)  
[www.bcogc.ca](http://www.bcogc.ca)



## ESTABLISHED HYDROCARBON RESERVES

December 31, 2010 (SI Units)

Table I

	Oil <sup>1</sup> (10 <sup>3</sup> m <sup>3</sup> )	Raw Gas <sup>1</sup> (10 <sup>6</sup> m <sup>3</sup> )
Initial Reserves, Current Estimate	131,840	1,724,769
Drilling 2010	+28	+275,942
Revisions 2010	+643	+33,691
Production 2010	-1,270	-33,202
Cumulative Production Dec. 31, 2010	-113,197	-792,798
Remaining Reserves Estimate Dec. 31, 2010	18,653	931,971

<sup>1</sup> Crude Oil and Raw Gas figures are taken from current and previous Hydrocarbon Reserves Reports. Any discrepancies in balancing are attributed to system rounding and production history reconciliation.

NOTE: Gas volumes measured at 101.325 kPa and 15 °C

December 31, 2010 (Imperial Units)

Table II

	Oil <sup>1</sup> (MSTB)	Raw Gas <sup>1</sup> (BCF)
Initial Reserves, Current Estimate	831,078	61,218
Drilling 2010	+176	+9,794
Revisions 2010	+4,046	+1,196
Production 2010	-7,992	-1,178
Cumulative Production Dec. 31, 2010	-712,337	-28,139
Remaining Reserves Estimate Dec. 31, 2010	117,381	33,079

<sup>1</sup> Crude Oil and Raw Gas figures are taken from current and previous Hydrocarbon Reserves Reports. Any discrepancies in balancing are attributed to system rounding and production history reconciliation.

NOTE: Gas volumes measured at 14.65 psi and 60 °F

## 1. OIL RESERVES

### Historical Record of Established Reserves<sup>1</sup> (10<sup>3</sup> m<sup>3</sup>)

Table III(a)

Year	Initial Reserve Current Estimate	Yearly Drilling	Yearly Revisions	Yearly Other	Production in Year	Cumulative Production at Year-End	Remaining Reserves at Year-End
1977	72,841	4,159	(84)		2,201	46,318	26,523
1978	77,826	2,650	2,376		2,004	48,280	29,546
1979	78,882	427	629		2,140	50,397	28,485
1980	80,043	234	927		2,002	52,399	27,644
1981	79,968	143	(218)		2,060	54,459	25,509
1982	80,760	126	666		2,095	56,554	24,206
1983	82,149	661	727		2,079	58,634	23,515
1984	79,551	781	(3,378)		2,113	60,747	18,805
1985	82,887	1,767	1,569		1,944	62,691	20,196
1986	83,501	456	144		2,010	64,701	18,786
1987	84,201	631	68		2,084	66,793	17,361
1988	85,839	1,238	(50)		1,937	68,759	16,623
1989	89,899	2,306	2,402		1,978	70,737	19,129
1990	90,650	569	181		1,954	72,714	17,823
1991	91,606	233	630		1,974	74,689	16,911
1992	94,030	823	1,596		2,017	76,750	17,273
1993	96,663	803	1,830		1,976	78,726	17,925
1994	99,619	1,477	1,482		1,929	80,664	18,956
1995	102,823	2,887	290		1,997	82,658	20,167
1996	106,009	1,306	1,878		2,205	84,856	21,153
1997	110,765	3,199	1,561		2,525	87,401	23,364
1998	116,294	815	4,717		2,670	90,105	26,189
1999	118,840	345	2,201		2,338	92,453	26,388
2000	122,363	504	3,018		2,568	95,031	27,357
2001	123,048	106	582		2,569	97,591	25,478
2002	122,245	427	(1,233)		2,426	99,977	22,313
2003	124,660	424	1,990		2,203	102,234	22,426
2004	125,953	154	947	188	2,015	104,104	21,873
2005	126,941	247	636	110	1,750	106,086	20,857
2006	125,845	222	(1,322)		1,631	107,603	18,244
2007	128,971	266	2,859		1,520	109,283	19,692
2008	129,117	162	25		1,341	110,632	18,485
2009	131,172	289	1,766		1,282	111,924	19,252
2010	131,840	643	28		1,270	113,197	18,653

<sup>1</sup> These values are taken from previously published ministry reserve estimates. This compilation is provided for historical value and to aid in statistical analysis only. Values shown for any given year may not balance due to changes in production and estimates over time.

## 2. RAW GAS RESERVES

Historical Record of Established Reserves<sup>1</sup> (10<sup>6</sup> m<sup>3</sup>)  
Table III(b)

Year	Initial Reserve Current Estimate	Yearly Drilling	Yearly Revisions	Yearly Other	Production in Year	Cumulative Production at Year-End	Remaining Reserves at Year-End
1977	376,960	18,119	(14,107)		11,039	143,958	233,002
1978	399,535	21,190	1,386		9,943	153,900	245,635
1979	424,805	26,142	(872)		11,394	165,294	259,511
1980	462,596	28,909	8,882		8,968	174,262	288,334
1981	478,689	13,842	2,251		8,293	182,555	296,134
1982	488,316	7,765	1,862		7,995	190,550	297,766
1983	490,733	2,550	(133)		7,845	198,395	292,338
1984	496,703	1,798	4,172		8,264	206,659	290,044
1985	505,233	2,707	5,823		8,799	215,458	289,775
1986	501,468	4,822	(8,463)		8,506	223,964	277,628
1987	497,466	1,986	(5,940)		9,810	233,794	263,777
1988	500,738	6,083	(1,661)		10,275	244,249	256,483
1989	513,662	12,193	(2)		13,276	257,862	255,782
1990	547,058	27,683	5,888		13,226	271,344	275,685
1991	574,575	24,708	3,812		15,162	285,965	288,582
1992	591,356	6,377	10,404		16,510	302,916	288,408
1993	617,379	22,901	3,122		18,202	321,090	296,246
1994	635,774	22,004	(3,301)		19,069	339,861	295,885
1995	657,931	21,065	1,051		21,157	361,106	296,825
1996	677,769	16,083	3,852		21,435	382,332	295,437
1997	688,202	12,835	(2,394)		22,811	405,157	283,045
1998	712,677	9,957	14,502		23,375	428,822	283,855
1999	743,816	13,279	17,824		23,566	453,000	290,816
2000	772,221	13,832	14,571		23,894	477,381	294,800
2001	811,146	7,199	31,690		26,463	504,620	306,526
2002	843,612	19,004	13,462		28,348	533,548	310,064
2003	889,488	19,317	26,282		26,639	562,560	326,928
2004	973,771	6,412	65,149	12,897	26,430	584,033	389,738
2005	1,065,288	8,974	63,268	19,104	27,854	620,696	444,592
2006	1,114,562	15,356	33,912		28,056	652,137	462,425
2007	1,172,136	21,468	36,109		29,362	689,209	482,927
2008	1,328,729	6,559	150,167		30,346	722,769	605,280
2009	1,415,172	30,331	56,133		30,846	757,291	657,881
2010	1,724,769	275,942	33,691		33,202	792,798	931,971

<sup>1</sup> These values are taken from previously published ministry reserve estimates. This compilation is provided for historical value and to aid in statistical analysis only. Values shown for any given year may not balance due to changes in production and estimates over time.

## ESTABLISHED OIL RESERVE CHANGES

Established Oil Reserve Changes ( $10^3 \text{ m}^3$ )  
Table IV

Field	Pool	Amount of I.R. Change ( $10^3 \text{ m}^3$ )	Reason for Change
<b>REVISION 2010</b>			
Boundary Lake	Boundary Lake A	+ 249	Performance review
Stoddart	North Pine G	+ 156	
Cache Creek	Doig H	- 130	Depleted
	* Others	+ 368	
<b>SUBTOTAL REVISIONS</b>		+ 643	
<b>DRILLING 2010</b>			
Cache Creek	Doig BB	+ 28	New drilling
<b>SUBTOTAL DRILLING</b>		+ 28	
<b>TOTAL</b>		+ 671	

\*Others – includes all additional changes both positive and negative.

## ESTABLISHED RAW GAS RESERVE CHANGES

Established Raw Gas Reserve Changes ( $10^6 \text{ m}^3$ )  
Table V

Field	Pool	Amount of I.R. Change ( $10^6 \text{ m}^3$ )	Reason for Change
<b>REVISION 2010</b>			
Sierra	Jean Marie	+ 5,660	R/P < 1
Town	Montney A	+ 4,532	Pool Amalgamation
Kobes	Doig Phos-Mont C	+ 3,448	Negative Res.
Ojay	Baldonnel	+ 2,966	CAPP Review
Monias	Montney C	- 5,946	Revised Mapping
Sukunka	Pardonet-Bald. E	- 1,178	CAPP Review
	*Others	+ 24,209	
	<b>SUBTOTAL REVISIONS</b>	<b>+ 33,691</b>	
<b>DRILLING 2010</b>			
Horn River	Muskwa-Otter Park A	+ 114,111	Mapping
Horn River	Muskwa-Otter Park B	+ 65,343	Mapping
Horn River	Muskwa-Otter Park C	+ 35,675	Mapping
Horn River	Evie A	+ 32,443	Mapping
Horn River	Evie B	+ 15,593	Mapping
Horn River	Evie C	+ 9,965	
	*Others	+ 2,812	
	<b>SUBTOTAL DRILLING</b>	<b>+ 275,942</b>	
<b>TOTAL</b>		<b>+ 309,633</b>	

\*Others - includes all additional changes both positive and negative

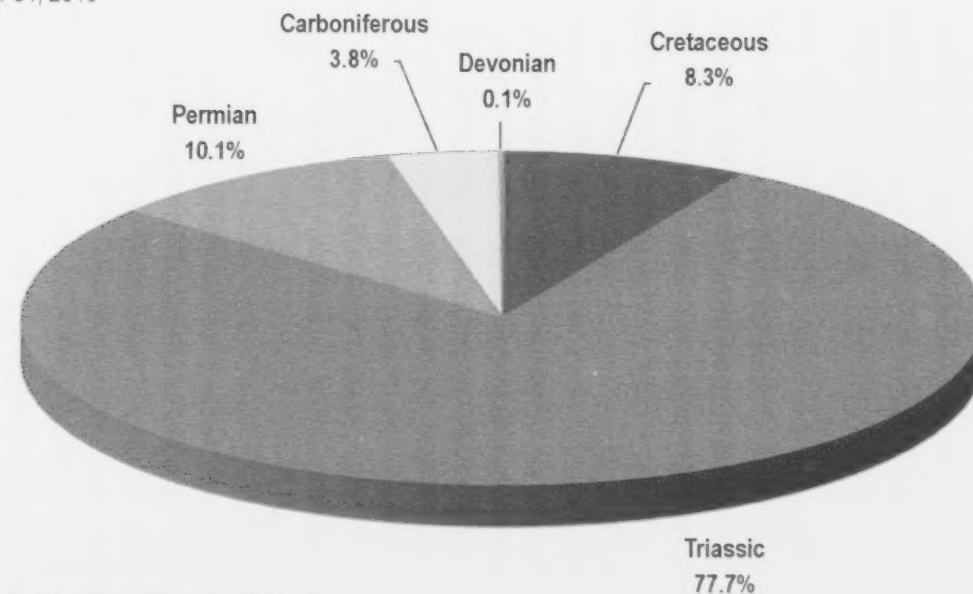


## RESERVES BY GEOLOGICAL PERIOD

Figure 11: Initial Oil and Raw Gas Reserves by Geological Period

### Initial Oil Reserves

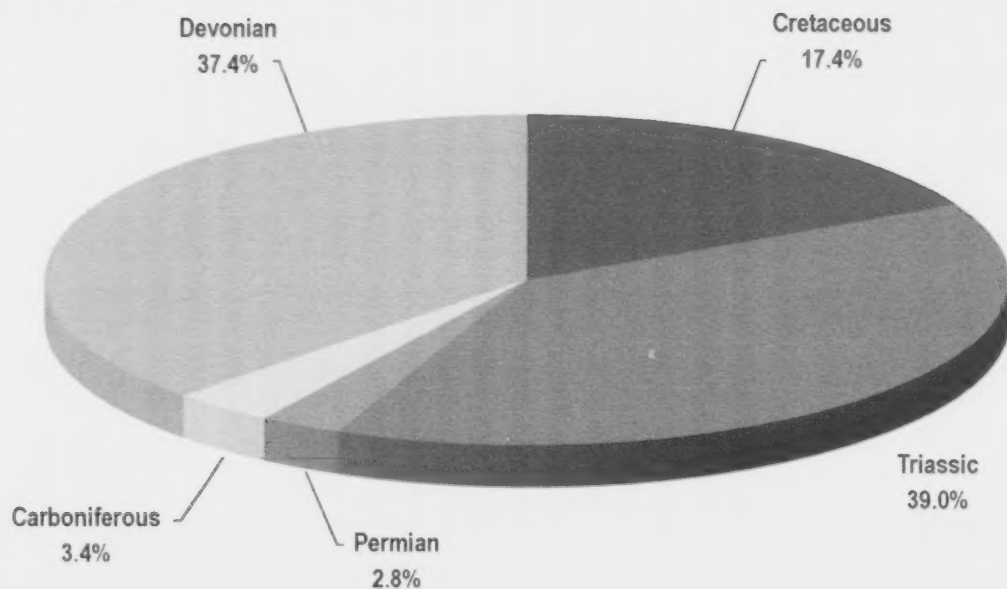
as of December 31, 2010



Total: 131.8 Million Cubic Metres

### Initial Raw Gas Reserves by Geological Period

as of December 31, 2010



Total: 1,724.8 Billion Cubic Metres

Initial Recoverable Oil Reserves by Geological Period ( $10^6 \text{ m}^3$ )  
Table VI(a)

CRETACEOUS	
Doe Creek	0.009
Bluesky	7.615
Bluesky/Gething	0.004
Gething	2.166
Cadomin	0.015
Chinkeh	0.315
Dunlevy	0.820
Lower Dunlevy	0.047
<b>SUBTOTAL</b>	<b>10.992</b>

TRIASSIC	
Nordegg Baldonnel	0.019
Baldonnel	1.495
Charlie Lake	0.016
Siphon	0.499
Cecil	6.630
Flatrock	0.027
Boundary Lake	39.364
Coplin	0.292
Septimus	0.001
Mica	0.339
Blueberry	0.009
Inga	7.287
North Pine	1.708
Bear Flat	0.345
Wilder	0.003
Pingel	0.012
"A" Marker/Base of Lime	0.077
Artex	2.323
Halfway	35.522
Lower Halfway	4.221
Doig	2.245
Lower Charlie Lake/Montney	0.071
Montney	0.102
<b>SUBTOTAL</b>	<b>102.609</b>

\*Totals may not match Table III(a) due to rounding.

Initial Recoverable Oil Reserves by Geological Period (10<sup>6</sup> m<sup>3</sup>)  
Table VI(a)

PERMIAN	
Belloy	10.381
Belloy-Kiskatinaw	2.941
<b>SUBTOTAL</b>	<b>13.322</b>

CARBONIFEROUS	
Taylor Flat	0.011
Kiskatinaw	0.022
Debolt	3.952
Shunda	0.056
Pekisko	0.888
Banff	0.052
<b>SUBTOTAL</b>	<b>4.981</b>

DEVONIAN	
Jean Marie	0.161
<b>SUBTOTAL</b>	<b>0.161</b>
<b>TOTAL</b>	<b>132.065</b>

\*Totals may not match Table III(a) due to rounding.

## RAW GAS

Initial Recoverable Raw Gas Reserves by Geological Period (10<sup>9</sup> m<sup>3</sup>)  
Table VI(b)

CRETACEOUS	
Quaternary	0.015
Cardium Sand	0.040
Doe Creek	0.564
Dunvegan	0.084
Paddy	4.598
Cadotte	16.156
Peace River	0.200
Spirit River	0.028
Notikewin	25.766
Falher	0.437
Falher A	5.272
Falher B	3.948
Falher C	3.956
Falher D	0.695
Falher E	0.003
Falher F	0.234
Falher G	0.056
Bluesky	40.115
Basal Bluesky	2.082
Bluesky Gething	13.004
Bluesky-Gething-Detrital	1.590
Detrital	0.230
Gething	25.283
Lower Gething	0.325
Basal Gething	0.270
Gething Baldonnel	0.356
Cadomin	57.034
Chinkeh	6.967
Nikanassin	32.265
Dunlevy	56.928
Lower Dunlevy	0.064
Nordeg	0.176
<b>SUBTOTAL</b>	<b>299.415</b>

\*Totals may not match Table III(b) due to rounding

## RAW GAS

Initial Recoverable Raw Gas Reserves by Geological Period (10<sup>9</sup> m<sup>3</sup>)  
Table VI(b)

TRIASSIC	
Nordegg/Baldonnel	1.899
Pardonet	0.498
Pardonet/Baldonnel	67.328
Baldonnel	98.529
Baldonnel/Upper Charlie Lake	58.326
Charlie Lake	3.280
Siphon	1.167
Cecil	3.506
Nancy	0.122
First Green Marker	0.017
Second Brown Marker	0.027
Boundary Lake	5.866
Basal Boundary	0.073
Yellow Marker	0.042
Coplin	3.226
Kobes	0.160
Blueberry	0.290
Farrell	0.002
Inga	5.806
North Pine	4.707
Bear Flat	0.770
Pingel	0.100
Tea Creek Member	0.084
Trutch Creek	0.107
Limestone A Bed	0.052
"A" Marker/Base of Lime	1.953
Lower Charlie Lake Sands	0.190
Artex	2.333
Artex Halfway	0.913
Upper Halfway	0.489
Halfway	117.617
Lower Halfway	4.290
Doig	24.695
Doig Phosphate Beds	0.340
Bluesky/Gething/Montney	29.500
Lower Charlie Lake/Montney	3.335
Doig Phosphate-Montney	7.065
Montney	223.729
<b>SUBTOTAL</b>	<b>672.437</b>

\*Totals may not match Table III(b) due to rounding.



## RAW GAS

Initial Recoverable Raw Gas Reserves by Geological Period (10<sup>9</sup> m<sup>3</sup>)  
Table VI(b)

PERMIAN	
Belloy	33.569
Fantasque	0.111
Lower Belloy	0.827
Belcourt	2.221
Belcourt-Taylor Flat	10.035
Belloy/Kiskatinaw	0.949
<b>SUBTOTAL</b>	<b>47.712</b>

CARBONIFEROUS	
Taylor Flat	7.868
Mississippian	0.159
Mattson	2.498
Kiskatinaw	2.201
Lower Kiskatinaw	1.526
Basal Kiskatinaw	4.551
Golata	0.199
Upper Debolt	0.242
Debolt	37.178
Lower Debolt	0.143
Elkton	0.590
Shunda	0.937
Pekisko	0.068
Banff	0.424
Exshaw	0.477
<b>SUBTOTAL</b>	<b>59.061</b>

\*Totals may not match Table III(b) due to rounding

## RAW GAS

Initial Recoverable Raw Gas Reserves by Geological Period (10<sup>9</sup> m<sup>3</sup>)  
Table VI(b)

DEVONIAN	
Kotcho	0.279
Wabamun	9.247
Kakisa	1.560
Jean Marie	102.977
Muskwa-Otter Park	215.217
Middle Devonian	0.061
Slave Point	115.433
Sulphur Point	2.222
Evie	57.022
Nahanni	5.484
Nahanni-Headless	0.125
Pine Point	131.005
<b>SUBTOTAL</b>	<b>645.577</b>
<b>TOTAL</b>	<b>1719.203</b>

\*Totals may not match Table III(b) due to rounding.

## OIL POOLS UNDER WATERFLOOD

Oil Pools Under Waterflood ( $10^3 \text{ m}^3$ )

Table VII

Field	Pool	Initial Reserves ( $10^3 \text{ m}^3$ )	Remaining Reserves ( $10^3 \text{ m}^3$ )
Beatton River	Halfway G	470	49
Beatton River West	Bluesky A (Unit 1)	943	14
Beavertail	Halfway B	91	5
Beavertail	Halfway H	182	22
Birch	Baldonnel C	215	66
Boundary Lake	Boundary A	38,099	3,015
Bubbles North	Coplin A	58	22
Crush	Halfway A + B	566	13
Currant	Halfway D (Unit 1)	24	16
Desan	Pekisko	784	173
Eagle	Belloy-Kiskatinaw	2,772	331
Eagle West	Belloy A (Unit 1)	6,569	396
Elm	Gething B	169	44
Hay River	Bluesky	6,207	2,665
Inga	Inga A (Unit 1, 2, 4, 5)	7,217	436
Lapp	Halfway C	457	31
Lapp	Halfway D	166	19
Milligan Creek	Halfway A (Unit 1, 2)	7,440	66
Muskrat	Boundary Lake A	401	119
Muskrat	Lower Halfway A	116	11
Oak	Cecil B	127	30
Oak	Cecil C	363	71
Oak	Cecil E	631	44
Oak	Cecil I	267	48
Owl	Cecil A	353	41
Peejay	Halfway (Unit 1, 2, 3 + CNRL)	10,579	166
Peejay West	Halfway A	525	104
Red Creek	Doig C	218	73
Rigel	Cecil B	576	17
Rigel	Cecil G	490	81
Rigel	Cecil H	910	53
Rigel	Cecil I	858	128
Rigel	Halfway C (Archean + Unit 1)	203	7
Rigel	Halfway Z	21	14

\*Totals may not match Table III due to rounding

## OIL POOLS UNDER WATERFLOOD

Oil Pools Under Waterflood ( $10^3 \text{ m}^3$ ) (continued)  
Table VII

Field	Pool	Initial Reserves ( $10^3 \text{ m}^3$ )	Remaining Reserves ( $10^3 \text{ m}^3$ )
Squirrel	North Pine C	413	5
Stoddart	North Pine G	156	101
Stoddart West	Bear Flat D	155	5
Stoddart West (partial)	Belloy C (Anderson)	1,446	132
Stoddart West	North Pine D	38	17
Sunset Prairie	Cecil A	353	24
Sunset Prairie	Cecil C	147	28
Sunset Prairie	Cecil D	152	51
Two Rivers	Siphon A	274	75
Weasel	Halfway (Unit 1, 2)	3,439	153
Wildmint	Halfway A (Unit 1)	1,554	17
<b>TOTAL</b>		<b>97,194</b>	<b>8,999</b>
<b>% OF TOTAL BRITISH COLUMBIA RESERVES</b>		<b>73.6</b>	<b>47.6</b>

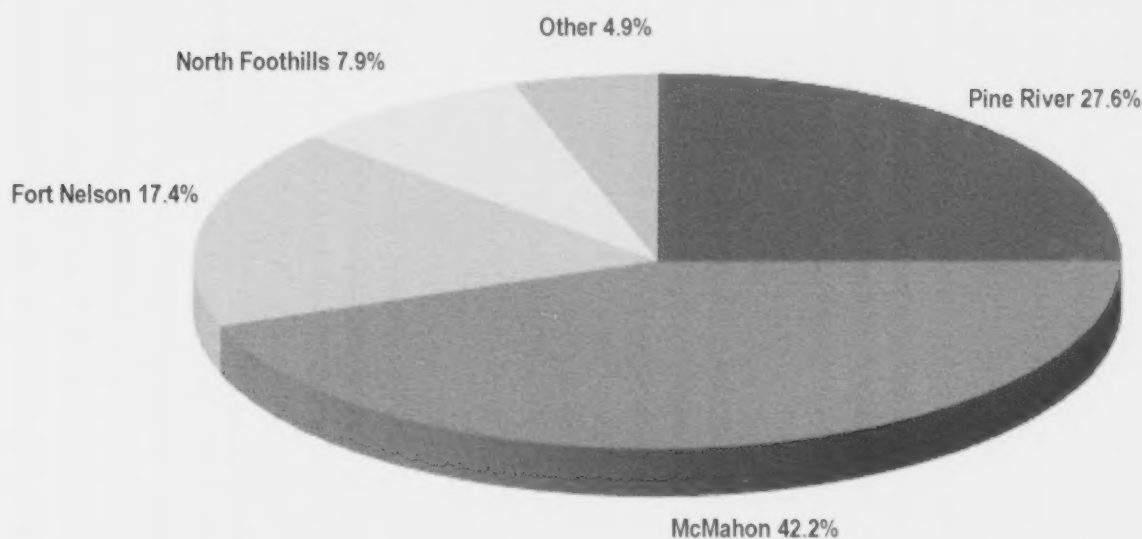
Oil Pools Under Gas Injection ( $10^3 \text{ m}^3$ )  
Table VIII

Field	Pool	Initial Reserves ( $10^3 \text{ m}^3$ )	Remaining Reserves ( $10^3 \text{ m}^3$ )
Bulrush	Halfway A	369	61
Cecil Lake	Cecil D	357	48
Rigel (approved only)	Halfway H	105	15
Stoddart West (partial) <sup>1</sup>	Belloy C (Phillips)	425	52
<b>TOTAL</b>		<b>1,271</b>	<b>176</b>
<b>% OF TOTAL BRITISH COLUMBIA RESERVES</b>		<b>1.00</b>	<b>.90</b>

<sup>1</sup> This pool has implemented one gas-injection scheme (Phillips Project) in addition to the waterflood scheme (Anderson Project).

## UNCONNECTED GAS RESERVES BY PLANT AREA

Figure 12: Unconnected Gas Reserves by Plant Area  
Remaining Reserves (Raw)



Total: 22.2 Billion Cubic Metres  
as of December 31, 2010

Unconnected Gas Reserves by Plant Area ( $10^9 \text{ m}^3$ )  
Table IX

Plant Name	Initial Remaining Raw Gas ( $10^9 \text{ m}^3$ )
<sup>1</sup> Pine River (c-85-D/93-P-12)	6.1
McMahon (5-31-82-17)	9.3
Fort Nelson (b-84-G/94-J-10)	3.8
<sup>2</sup> North Foothills	1.7
Other	1.1
<b>TOTAL</b>	<b>22.1</b>

\* Totals may not add up due to rounding

<sup>1</sup> Includes BRC Elmworth (4-8-70-11-W6) and Burlington Noel (b-59-D/093-P-8)

<sup>2</sup> Includes WGSJ Buckinghorse (a-81-H/094-G-5), Anadarko Cypress (b-99-C/094-B-16) and WEI Sikanni (b-41-I/094-G-3)



## PROJECT/UNIT CROSS-REFERENCE LISTING

Table X

Project Type	Description
CONC .....	Concurrent Production
EOR .....	Enhanced Oil Recovery
GEPG .....	Good Engineering Practice - Gas
GEPO .....	Good Engineering Practice - Oil
PMGI .....	Pressure Maintenance - Gas Injection
PMWF .....	Pressure Maintenance - Water Flood
UNIT .....	Unitization

For a complete project/unit cross-reference listing, please visit our website: [www.bcogc.ca](http://www.bcogc.ca)  
Access Web Applications/Data Downloads

### Definitions: SI Units

British Columbia's reserves of oil, natural gas liquids and sulphur are presented in the International System of Units (SI). The provincial totals and a few other major totals are shown in both SI units and the Imperial equivalents in the various tables. Conversion factors used in calculating the Imperial equivalents are listed below:

1 cubic metre of gas (101.325 kilopascals and 15° Celsius)	=	35.493 73 cubic feet of gas (14.65 psia and 60° Fahrenheit)
1 cubic metre of ethane (equilibrium pressure and 15° Celsius)	=	6.330 0 Canadian barrels of ethane (equilibrium pressure and 60° Fahrenheit)
1 cubic metre of propane (equilibrium pressure and 15° Celsius)	=	6.300 0 Canadian barrels of propane (equilibrium pressure and 60° Fahrenheit)
1 cubic metre of butanes (equilibrium pressure and 15° Celsius)	=	6.296 8 Canadian barrels of butanes (equilibrium pressure and 60° Fahrenheit)
1 cubic metre of oil or pentanes plus (equilibrium pressure and 15° Celsius)	=	6.292 9 Canadian barrels of oil or pentanes plus (equilibrium pressure and 60° Fahrenheit)
1 cubic metre of water (equilibrium pressure and 15° Celsius)	=	6.290 1 Canadian barrels of water (equilibrium pressure and 60° Fahrenheit)
1 tonne	=	0.984 206 4 (U.K.) long tons (2,240 pounds)
1 tonne	=	1.102 311 short tons (2,000 pounds)
1 kilojoule	=	0.948 213 3 British thermal units (Btu as defined in the federal <i>Gas Inspection Act</i> [60° - 61° Fahrenheit])

## DEFINITIONS

---

### Reserves Terminology

#### Original Gas and Original Oil in Place

The volume of oil, or raw natural gas calculated or interpreted to exist in a reservoir before any volume has been produced.

#### Established Reserves

Those reserves recoverable under current technology and present and anticipated economic conditions, specifically proved by drilling, testing, or production; plus that judgement portion of contiguous recoverable reserves that are interpreted from geological, geophysical, or similar information, with reasonable certainty to exist.

#### Initial Reserves

Established reserves prior to the deduction of any production.

#### Remaining Reserves

Initial established reserves less cumulative production.

### Definitions of Other Terms

#### Area

The area used to determine the adjusted bulk rock volume of the oil, or gas-bearing reservoir, usually the area of the zero isopach or the assigned area of a pool or deposit.

#### Butane

In addition to its normal scientific meaning, a mixture mainly of butanes which ordinarily may contain some propane or pentanes plus.

#### Compressibility Factor

A correction factor for non-ideal gas determined for gas from a pool at its initial reservoir pressure and temperature and, where necessary, including factors to correct for acid gases.

#### Condensate

A mixture mainly of pentanes and heavier hydrocarbons that may be contaminated with sulphur compounds that is recovered or is recoverable at a well from an underground reservoir and that may be gaseous in its virgin reservoir state but is liquid at the conditions under which its volume is measured or estimated.

#### Density

The mass or amount of matter per unit volume.

#### Density, Relative (Raw Gas)

The density, relative to air, of raw gas upon discovery, determined by an analysis of a gas sample representative of a pool under atmospheric conditions.

## DEFINITIONS

### Definitions of Other Terms

#### **Discovery Year**

The year in which the well that discovered the oil or gas pool finished drilling.

#### **Formation Volume Factor**

The volume occupied by one cubic metre of oil and dissolved gas at reservoir pressure and temperature, divided by the volume occupied by the oil measured at standard conditions.

#### **Gas (Non-associated)**

Gas that is not in communication in a reservoir with an accumulation of liquid hydrocarbons at initial reservoir conditions.

#### **Gas Cap (Associated)**

Gas in a free state in communication in a reservoir with crude oil, under initial reservoir conditions.

#### **Gas (Solution)**

Gas that is dissolved in oil under reservoir conditions and evolves as a result of pressure and temperature changes.

#### **Gas (Raw)**

A mixture containing methane, other paraffinic hydrocarbons, nitrogen, carbon dioxide, hydrogen sulphide, helium, and minor impurities, or some of them, which is recovered or is recoverable at a well from an underground reservoir and which is gaseous at the conditions under which its volume is measured or estimated.

#### **Gas (Marketable)**

A mixture mainly of methane originating from raw gas, if necessary, through the processing of the raw gas for the removal or partial removal of some constituents, and which meets specifications for use as a domestic, commercial, or industrial fuel or as an industrial raw material.

#### **Gas-Oil Ratio (Initial Solution)**

The volume of gas (in thousand cubic metres, measured under standard conditions) contained in one stock-tank cubic metre of oil under initial reservoir conditions.

#### **Gross Heating Value (of dry gas)**

The heat liberated by burning moisture-free gas at standard conditions and condensing the water vapour to a liquid state.

#### **Liquid Petroleum Gases (LPG)**

A hydrocarbon mixture comprised primarily of propane and butanes. Some ethanes may be present.

#### **Mean Formation Depth**

The approximate average depth below kelly bushing of the mid-point of an oil or gas productive zone for the wells in a pool.

## DEFINITIONS

---

### Definitions of Other Terms

#### **Methane**

In addition to its normal scientific meaning, a mixture mainly of methane which ordinarily may contain some ethane, nitrogen, helium or carbon dioxide.

#### **Natural Gas Liquids**

Propane, butanes, or pentanes plus, or a combination of them, obtained from the processing of raw gas or condensate.

#### **Oil**

A mixture mainly of pentanes and heavier hydrocarbons that may be contaminated with sulphur compounds, that is recovered or is recoverable at a well from an underground reservoir, and that is liquid at the conditions under which its volume is measured or estimated, and includes all other hydrocarbon mixtures so recovered or recoverable except raw gas or condensate.

#### **Pay Thickness (Average)**

The bulk rock volume of a reservoir of oil or gas, divided by its area.

#### **Pentanes Plus**

A mixture mainly of pentanes and heavier hydrocarbons which ordinarily may contain some butanes and which is obtained from the processing of raw gas, condensate, or oil.

#### **Pool**

A natural underground reservoir containing or appearing to contain an accumulation of liquid hydrocarbons or gas or both separated or appearing to be separated from any other such accumulation.

#### **Porosity**

The effective pore space of the rock volume determined from core analysis and well log data, measured as a fraction of rock volume.

#### **Pressure (Initial)**

The reservoir pressure at the reference elevation of a pool upon discovery.

#### **Project/Units**

A scheme by which a pool or part of a pool is produced by a method approved by the Commission.

#### **Propane**

In addition to its normal scientific meaning, a mixture mainly of propane, which ordinarily may contain some ethane or butanes.

#### **Recovery**

Recovery of oil, gas or natural gas liquids by natural depletion processes or by the implementation of an artificially improved depletion process over a part or the whole of a pool, measured as a volume or a fraction of the in-place hydrocarbons so recovered.

#### **Saturation (Water)**

The fraction of pore space in the reservoir rock occupied by water upon discovery.

## DEFINITIONS

---

### Definitions of Other Terms

#### Surface Loss

A summation of the fractions of recoverable gas that are removed as acid gas and liquid hydrocarbons, used as lease or plant fuel, or flared.

#### Temperature

The initial reservoir temperature upon discovery at the reference elevation of a pool.

#### Unconnected Reserves

Gas reserves which have not been tied-in to gathering facilities and therefore do not contribute to the provincial supply without further investment.

#### Underbalanced Drilling

A technique in which the hydrostatic pressure in the circulating downhole fluid system is maintained at some pressure less than the pressure of the target formation.

#### Zone

Any stratum or any sequence of strata that is designated by the Commission as a zone.